



## Bio-Imaging Research, Inc.

# Non-Destructive Examination and Assay of Drums Containing Transuranic Waste

### Technology Need:

Characterization of contents of nuclear waste drums is required for disposition decisions, safe transportation, treatment, and permanent storage. The movement of retrievable drums on and off temporary storage sites is regulated for safety and environmental reasons. Examination of the contents is expensive, because of safety precautions necessary when handling nuclear waste.

Currently nondestructive examination (NDE) techniques such as real-time radiography (RTR) lack capabilities for measuring free liquid volumes and nondestructive assay (NDA) techniques such as segmented gamma scanning (SGS) lack the ability to determine total gram equivalent of Plutonium-239 ( $^{239}\text{Pu}$ ) for the variety of nuclear waste matrices with low-level gamma emissions from transuranic waste.

### Technology Description:

This project integrates and demonstrates the results of two semitrailer based mobile inspection systems Waste Inspection Tomography (WIT) manufactured by Bio-Imaging Research, Inc. (BIR) and the Active and Passive Neutron Examination and Assay System (APNEA) manufactured by TRUtech. Together, these systems provide both NDE and NDA capabilities that include a multimodality approach to noninvasive nuclear waste drum characterization for transuranic (TRU) waste. This development effort integrates characterization data from x-ray, gamma emission, and neutron inspection systems to provide characterization data of TRU waste.

TRU waste isotopes are known to be low gamma emitters. Neutron based systems are known to be able to assay low gamma emission drums. They require both matrix and



**Drum being loaded into WIT**

geometry corrections in addition to isotopic data. APNEA alone cannot provide this data. However, the integration of WIT and APNEA can overcome these problems. WIT provides waste matrix geometry, and attenuation information as well as gamma isotropics and gamma tomography assays, while at the same time, APNEA can provide WIT with neutron assay information from drums that are poor gamma emitters. This combination can provide for complete noninvasive NDE/NDA from integrated mobile platforms. This integrated approach meets waste acceptance requirements for transuranic waste by providing the total gram equivalent of  $^{239}\text{Pu}$  for an entire waste drum with attenuation corrections based on matrix type and distribution.

### Benefits:

<Rapid characterization of 55-110 gallon drums for radioactive and waste matrix content and localization including heavy metals, wall thickness, free liquid volume, and location

<Effective for low level, transuranic, and mixed wastes in

a variety of matrices including cement, glass polymers, combustibles, loose soils, heterogeneous metals, and super compacted materials. The significant benefit is that the integration of WIT and APNEA data provides assay capability for both weak and strong gamma emitting waste in a variety of waste matrices

<Mobile systems optimize logistics

<Projects, Slices, and 3-D volume rendering of data fused images from x-ray, gamma emission, and neutron based data in near real-time provides for imaging drum contents for ready interpretation to facilitate evaluation, processing and disposition of drums

<Archived data can support engineering decisions and regulatory compliance by providing integrated reporting of x-rays, gamma, and neutron data to meet regulated waste acceptance criteria reporting

## Status and Accomplishments:

This project was completed in September 1998. The integration of WIT and the APNEA systems demonstrated the potential to prioritize and select a weighted average assay result, based on the expected bias and precision of each technique for a particular waste type (i.e., the potential to draw on the strengths of two assay systems to obtain more accurate and precise measurements). A shortcoming of the project was the limited data from the APNEA unit, which was provided by the subcontractor, TRUtech.



APNEA drum loading

As part of the Rapid Commercialization Initiative (RCI) verification test plan, BIR performed NDE and NDA on eight drums over the period January 20 to February 24, 1997. This demonstration was conducted at the Idaho National Engineering and Environmental Laboratory (INEEL) Radioactive Waste Management Complex.

In additional verification testing, the APNEA system was used to perform neutron scanning on a variety of INEEL waste matrices using both surrogate and real waste drums. APNEA completed drum inspections in April 1997. The field evaluation included testing the WIT and APNEA systems on an initial set of drums, followed by blind assay of drums. WIT drum data was transferred to APNEA for data integration (data fusion) to demonstrate improved APNEA neutron assay.

During May 1998, BIR completed the integration of APNEA assay results with the WIT system's Active and Passive Computed Tomography results for 4 drums.

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## Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 260  
<http://ost.em.doe.gov/tms>

The National Energy Technology Laboratory Internet address is <http://www.netl.doe.gov>

For more information, please visit BIR's website at <http://www.bio-imaging.com/>